

February 16, 1959

MEMORANDUM FOR: 

CHAL-1579
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SUBJECT : Status of Granger Box Jammer

25 YEAR RE-REVIEW

A. What does it accomplish operationally?1. A review of the objectives:

The objective of this project was to design a jammer that would nullify the use of AI X band radars (8-11kmc) when used in the AI tracking mode. No effort was to be made against AI radars on other bands (S, K or Q) nor against the X band AI in search mode nor against ground radars (search, height finder or fire control).

The objective included the nullifying of a missile guidance system when that system made use of the X band AI tracking signal. The USSR airborne missile (only one is known) uses a beam-rider guidance system in which the proper function of the AI X band tracking radar is essential. The Sparrow I is a U.S. beam rider system of this type. Also X band missile guidance systems using active pulse conical scan guidance systems for mid-course and/or homing were to be nullified. No effort was to be directed against non-pulse missile guidance systems. (infra-red).

Two other highly sophisticated guidance systems using X band missile guidance possibilities are under development and consideration in the U.S. Neither are yet operational. The objective of the Granger Box did not include the defeat of either of these systems. One is a variation of the conical scanning guidance system in which two antennas are used on the attacker, one not conical scanning and one conical scanning) (which might be called the one-way conical scan system). This system scans only in the receiving half of the system and therefore provides no indication outside of its own hardware that it is conical scanning.

The other is a monopulse system which uses two, four or five antennas (different versions) and gives no or little evidence (different versions give different indications) of scanning outside its own hardware. In no case does it give the easily recognizable conical scan indication.

A table summary of the objectives follows:

1. X band AI radar (normal scanner tracking mode) - Yes
- X band AI radar (Search mode) - No
2. X band missile guidance (active, beam-rider, or semi-active) - Yes
3. X band doppler missile arming and firing systems - Yes
- Infra-red missile guidance - No
- X band AI radar or missile guidance of the sophisticated (undeveloped) types (monopulse or one way conical scan) - No

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2. The reasoning behind these objectives was as follows:

What could be done in space and weight available that would be effective? The answer to this, was believed to be a repeater jammer for X band. Such a jammer with a one watt output was believed, on the basis of all data available, to be sufficient to nullify AI, normal-scanning, tracking radars. If successful in this nullifying, it was believed no airborne guns, rockets nor missiles could be successfully launched. The reasoning said that the attacking aircraft would not be able to get within visual sighting range without the use of his tracking radar since the tracking radar is his target locator from about ten miles range.

Should the attacking aircraft manage to get within visual range of a target without his AI tracking radar, say by superior GCI vectoring, use of the search mode of the AI radar or by some other technique not visualized (luck for instance), the nullification of his AI radar destroys his aiming device, other than the pilot's eyes. To aim the armament by eye was believed to be insufficient for a kill with guns and rockets (excepting nuclear warheaded rockets). For beam-rider missiles and X band active and semi-active, pulsed, conical-scan-guided missiles the visual launch would be of no value to the attacker since the missile would be as confused as the AI radar had been in the tracking mode. Visual launching of a missile with S band, K band, infra-red, non-pulsed X band, mono-pulse or one-way conical scan guidance would be effective at altitudes up to 40,000 feet or so. The result of visual launching at higher altitudes is not known to the writer.

In summary then, the Granger box had as its objective the nullifying of the use of the AI radar as a target tracker (which was believed to avoid visual contacts) and should visual contact occur would nullify most missile systems after launch. It would nullify the only known USSR airborne missile guidance system as well as the only known USSR airborne AI tracking systems.

3. What part of the objective has been accomplished to date?

All objectives above have been accomplished for the computer mode of X band AI tracking and launching of missiles.

Some of the more recent armaments systems (F-104 and F-106) in the U.S. have a mode of operation in which speaking in a gross way the human (the pilot) replaces the computer. This can be done with modern missiles, particularly in the pursuit mode, since good modern missile guidance can correct for the launch errors that would be likely with visual aiming. When the pilot is acting as the computer very long time constants (2 sec. in the F-106) are introduced into the pilot's indication of the launch error. This long time constant introduces a smoothing effect that cancels out random effects that the AI radar may perceive. Since the errors created by the Granger Box have a high degree of randomness, this mode of AI tracking has resisted consistently the effect of the jammer. It is clear to the writer that the AI radar can be used consistently in this mode in

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the F-104 and F-106 to bring the attacker into visual sight of the target. In the F-104 this mode is the only mode available to the pilot. The F-106 has an electronic computer mode which the Granger jammer defeats.

It should be remembered that although the above "human-computer" system might make a successful launch of the missile, a beam-rider missile (the only known USSR airborne missile) or an active or semi-active, pulsed-X band-guided missile would not make a kill since the missile must use an electronic computer, no human being available. Also as stated some paragraphs back, guns and rockets (excepting nuclear warhead rockets) could not be effective. Also X band doppler arming and firing procedures would be prematurely tripped and therefore, all missiles even if successfully launched, would be defeated if they used this very effective fuzing system.

*has not done*  
B. What part of the objective has not been accomplished?

The nullification of the AI radar (tracking mode) as a locator of the target for visual and launch purposes when the "human-computer" (long time constant) mode of operation is used has not been accomplished.

C. How would one proceed to carry out the objective of B above if this objective is required?

To answer this question the following two steps are recommended:

- Minimize jamming of D-104*
- Make a bench set-up using the F-106 radar and the Granger jammer to obtain more data on the phenomena existing in the "human-computer" mode of operation versus the electronic computer mode. An alternate to this is to instrument an aircraft carrying the F-106 radar in a manner similar to the Point Mugu instrumentation of the F-3H. The F-106 radar bench set up at Edwards would provide if available, a good start on the first procedure. A suitable location for the Granger box several hundred yards away would be required and might be difficult.
  - As a result of the above data, it is anticipated that as a minimum more gain which will require more isolation will be required. It is also probable in my opinion that more gain and/or isolation will be required than the present box can provide. Dr. Ayer has suggested a limited gain and isolation program that will require about 30 days to carry out. Should it become necessary to provide a new box, considerably more time will be required before we can be successful against the "human-computer" type of operation.

D. Aren't we trying to make this box do too much?

★ By the time we accomplish B above some of the newer techniques listed under A may exist and may find ourselves with a perpetual design problem.

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*premature until  
tests complete*

I would recommend that we start production of the Granger Box at once concurrently try as an experiment, Dry. Ayer's suggestion for improved operations against the "human computer" type mode of the F-106 and F-104. Should this be successful, it could be integrated into the production without loss of time or money thirty days hence. Should it fail, we would use the boxes as they now exist.

It is certain that in order to be effective against all of the newer concepts in AI, we will need more gain, more isolation and more power. It is not certain that these three factors alone will allow us to conquer all of these concepts. It is probable in my opinion, that we will need all three to conquer "human-computers". It would seem obvious to me that we should stop this R&D effort and start a new project (which you have stated is operationally not defensive) with higher power if we want to conquer these new AI techniques.

*Need operational specification here  
before additional work. This  
specification must be based  
on life expectancy and time of  
development of system as anticipated  
USSR improvements in design and  
newer concepts of equipments.*

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## Distribution:

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